

Formation and Symmetry Control of Fuel Layers in a NIF-Scale Hohlraum.

We have made the first good D_2 ice layers in a hohlraum and have demonstrated ability to control the symmetry of these layers. The ice layer grows on the inside of a 2-mm-diameter plastic shell suspended in a NIF-scale hohlraum. A ring of infrared (IR) laser power is projected through each laser entrance hole and is scattered off the carefully prepared, nearly Lambertian hohlraum wall (Figure 1). The D_2 is symmetrically redistributed inside the shell by absorption of the uniformly scattered IR power. The shadowgraph image of the ice layer at the hohlraum midplane has an rms roughness of $8\text{ }\mu\text{m}$ (Figure 2). Neglecting the lowest two modes gives a $2.6\text{-}\mu\text{m}$ rms roughness that approaches the NIF smoothness require-

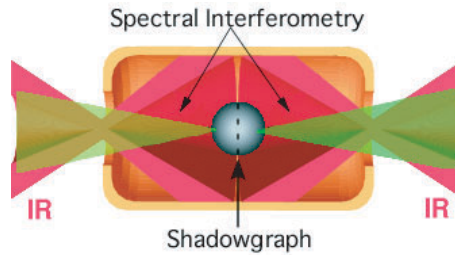


Figure 1. Infrared heating and characterization of fuel layers in hohlraums.

ment of $1\text{-}\mu\text{m}$ rms. The amplitude of the first two azimuthal modes can be reduced by optimizing the IR alignment. Spectral interferometry and shadowgraph ice thickness measurements are used to optimize the IR pointing and side-to-side power balance. The measured ice response to IR tuning is reproduced in a complete ray-tracing and thermal model of this experiment. With this successful demonstration of IR layering in a

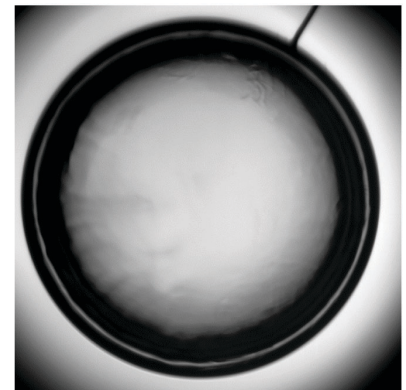


Figure 2. Shadowgraph image of D_2 fuel layer formed in a hohlraum.

hohlraum, future experiments will now focus on slower growth to reach NIF smoothness requirements, as previously demonstrated in capsules inside integrating spheres. This work is done in collaboration with General Atomics and Schafer Corporation.

Efficient, $>10\text{ keV}$ X-Ray Source Production.

Efficient, bright, laser-produced x-ray sources at photon energies above 6 keV are a challenge to produce because convective and soft x-ray radiative losses incurred with solid targets limit the plasma temperature. Nevertheless, hard x-ray sources are essential for future experiments at NIF, many of which

require such sources for radiography between 10 and 20 keV .

To address this need and others, recent experiments performed in collaboration with Q Division and the Naval Research Laboratory at the OMEGA laser in Rochester, NY, have demonstrated creation of 13-keV photons at near 1%

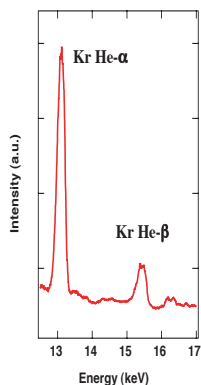


Figure 1. Time-integrated He-like Kr spectrum from a 0.5 atm gas-filled target.

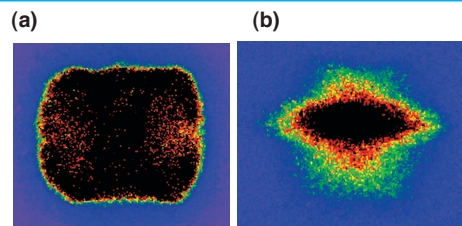


Figure 2. (a) X-ray image at 0.8 ns showing full target diameter of 1.5 mm and length of 1.2 mm in emission. (b) X-ray image at 1.8 ns ; same scale as previous image, but emission is localized on axis.

efficiency using $0.5\text{--}2\text{ atm}$ Kr gas-filled low-Z cylinders. The gas is supersonically heated by forty $0.35\text{-}\mu\text{m}$ wavelength, 1-ns square laser beams to produce He-like ions that radiate K-shell emission over millimeter dimensions (see Figures 1 and 2). Previous work on gas-filled Xe and Ar targets has shown an order of magnitude gain in $3\text{--}6\text{ keV}$ x-ray conversion efficiency over disk targets, and also that K-shell emitters can be more efficient than L-shell emitters for equivalent electron temperature. Kr gas was chosen to take advantage of these properties. Targets filled with 0.5 to 2.0 atm of Kr gas produce conversion

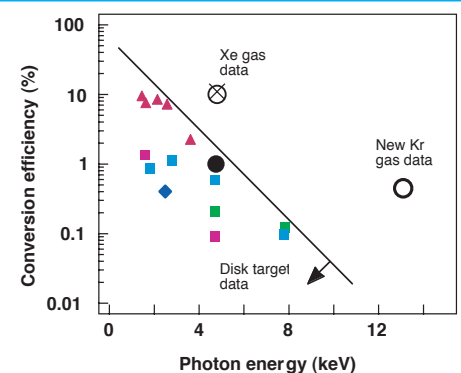


Figure 3. X-ray conversion efficiency from gas-filled targets (open symbols) and disk targets (filled symbols) irradiated with $0.35\text{-}\mu\text{m}$ laser light. New Kr gas data is ~ 2 orders of magnitude above the projected disk x-ray conversion efficiency.

efficiencies from 0.3 to 0.6% , which represent at least a $100\times$ improvement in conversion efficiency at 13 keV over what is predicted for solid targets (see Figure 3). Surprisingly, the lowest fill produces the highest conversion efficiency. This is ascribed to compression of the lower-fill Kr plasmas by the inwardly ablating cylinder walls, prolonging the emission after laser heating.